

## COMPARING THE EFFECT OF EDPA AND FDPA ON UNIVERSITY STUDENTS' HOTS

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### ABSTRACT

A study was conducted on 120 students from two classes studying the Cognitive Sciences and Ethics course in Universiti Utara Malaysia. One class was treated with an editable drill and practice application (EDPA) while the other class received a fixed drill and practice application (FDPA). The purpose was to assess the effects of EDPA and FDPA on higher order thinking skills (HOTS). The main difference of the two applications is EDPA allow students to add and modify items based on personal inquiries while FDPA does not. From the literature review it seems that students if given the opportunity to ask questions tend to come up with both basic and deep questions. While the basic questions allowed students to acquire only basic knowledge, deeper questions allowed students to garner reflective skills which in turn should develop better HOTS. This led to the assumption that the use of EDPA is more effective than FDPA in promoting HOTS. Based on the independent-groups t-test results it was concluded that there was a significant difference in HOTS scores for the EDPA and FDPA. The results showed that students who were subjected to EDPA had better HOTS scores than those subjected to FDPA.

**Keywords:** EDPA, Higher Order Thinking Skills, T-Test.

### INTRODUCTION

The significance of higher order thinking skills (HOTS) cannot be undermined in the world of education. As a result of many challenges, it is however a matter of discussion the way in which HOTS can be developed among students. First, there are various perceptions accepted by philosophers as well as psychologists with regards to HOTS. Second, there is attempt to sustain variance between higher order thinking and lower order thinking. Third, is the distinction in the concepts of essential thinking and problem solving, as well as their significance with higher order thinking (Lewis & Smith, 1993). Nonetheless, most of the specialists accept that the effort of developing HOTS must be a constant process as the culture of education ought to concentrate on building an atmosphere which will encourage knowledge in a deeper sense rather than simply memorizing facts. For the purpose of acquiring significant knowledge a technique which can be implemented is promoting question-posing exercises in a form of drill and practice application (DPA).

Drill and practice application (DPA) is a form of computer-based educational package that performs the drill and practice learning technique which is well related to the behaviorist learning style. The main strengths of DPAs include enabling students to master specific skills as well as principles via repeated exercises followed with instant response. A form of DPA that was considered in order to support students in the act of framing and modifying questions is the editable drill and practice applications (EDPA) (Mohammad Shah & Ahmad Jelani, 2015). EDPA such as Peerwise and StudySieve allow students making use of it to add and modify items while FDPA on the other hand, does not permit students using it to add or alter items rather; they are required to practice with pre-existing items (Denny, Luxton-Reilly & Hamer, 2008; Luxton-Reilly, Denny, Plimmer & Bertinshaw, 2011). As opposed to the behaviorist style of just learning via answering the same questions repeatedly, EDPA allows students to

enhance their learning by evaluating their present knowledge and later create new and more meaningful DPA items. Additionally, learning with EDPA seems to include and also promote other helpful learning concepts including problem-based learning, self-regulated learning, community of practice and lifelong learning. Based on the outcomes of several reports (see Barak & Rafaeli, 2004; Denny et al., 2008; Luxton-Reilly et al., 2011), it appears that apart from mastering knowledge, EDPA also has the capacity to promote HOTS. This assertion however, still needs to be supported by more empirical results. Based on this concept, this research would like to establish how significant the use of EDPA is on developing students' HOTS as compared to the use of FDPA. Thus, the purpose of this study is to determine which of the two types of DPA – EDPA or FDPA has better effect on students' HOTS. The research question is “Is there a significant difference on HOTS scores between the groups of students using EDPA and FDPA?”

## LITERATURE REVIEW

### Definition of HOTS

The definition of higher order thinking has been explored by Lewis and Smith (1993) as they approached the topic from philosophical and psychological perspectives. Each of these fields has different views of “truth” – philosophers take the human approach while psychologists take the scientific approach. According to Cohen and Cowen (2008), HOTS include “skills to solve problems, to synthesize information from new creations, and to effectively make decisions that are based on solid understanding of surrounding conditions” (p. ii). Lewis and Smith (1993) have defined HOTS as different from critical thinking which is an assessment of arguments applied to problem solving activities. They have argued that HOTS can be developed by students when confronted by difficult situations since this will include getting information from the new situation and making decisions by understanding that situation.

### Develop HOTS through Questioning

Chin (2001) conducted a study to understand the questions asked by students that contribute towards knowledge construction. Six 8 graders were selected to ask basic questions about science and then followed by deeper questions for in-depth approach. Students were selected based on different academic efficiencies, and it was ensured that teacher's assessment was reflected on the students' responses to the questionnaire. It was concluded that basic questions did not allow students to develop any deep thinking and the replies were short while the deeper questions allowed them to think before giving longer conceptual answers.

### The Significance of Existing Knowledge

The study by Zohar & Dori (2003) seem to show that although some amount of knowledge is important for learning, the same is not necessary for motivating HOTS . However, several studies recommended that prior knowledge and skills can in fact aid higher-level operations (McCoubrie, 2004; Nicol & Anderson, 2000). From exercise routines to professionally vital skills, drills are recognized to be very helpful in promoting knowledge retention as well as skills. Researchers have found that whenever students were not subjected to nonstop lectures and were stopped in between classes and asked to make a note of their questions, they came up with new viewpoint to the subject and also performed much better in exams (Chin, 2001). This is really an extension of the fundamental teaching principle which requests teachers to motivate uncertainties and questions from students after any new concept is introduced into the class.

## Self Assessment

Self-assessment is critical in promoting self-regulation to enhance learning. This is presented in the works of Alfke (1974) and Jelly (1985), which showed that while getting them to ask question was simple, observing students begin self-analysis of the answers they received was an uncommon experience. To bring them to the self-assessment mode, they require some fundamentals as well as relevant knowledge to enable HOTS development and to actively employ them in analysing answers obtained to their questions. Barak and Rafaeli (2004) showed that peer assessment can promote self-assessment which resulted in improved learning (p. 88). Therefore, self-assessment based on Riordan and Loacker (2008) needs to be made “an important part of the assessment process to be done on a regular basis and also systematically” (p.181)

## Possibility of EDPA in Promoting HOTS

There are several EDPA found to be useful for promoting HOTS. Questions Sharing and Interactive Assignments (QSIA) is a “unified infrastructure for developing, collecting, managing and sharing of knowledge items” (Rafaeli, 2004, p.273). Using the QSIA, Barak and Rafaeli (2004) compared students who took on-line examination based on self and peer assessment. It was concluded that students who did peer assessment fared better than their counterparts. Denny et al. (2008) introduced Peerwise which is an online system of creating tests based on multiple choice questions. Its importance is emphasized since students get to answer more questions than required (p.73). The principle characteristic here is that students get to contribute the questions with instructors having the right to delete redundant questions. In another article, Luxton-Reilly et al. (2011) introduced StudySieve which is an online system of free-response type items. In StudySieve, the answers reflect the thinking talents of students, and therefore like the QSIA and Peerwise, this EDPA is also useful for higher level of learning.

## METHODOLOGY

This study was conducted to compare the performance level of university students in the context of HOTS after using both EDPA and FDPA. This study used a quantitative approach to collect data and make conclusions.

## Sample of Study

For the purpose of this study, 120 students were selected from two classes of the Cognitive Sciences and Ethics course. They were under the tutelage of the same lecturer in Universiti Utara Malaysia. The students were comprised of semester two to semester eight students, and studied various subjects like such as Business Studies and Computing. The study was conducted in a period of four months.

## Treatment Materials

For this study the EDPA and FDPA versions of KAJI that were used in the study by Mohammad Shah and Ahmad Jelani (2015) were given to the respective groups of students. There are two major differences between the two DPAs. Firstly, the EDPA allows students to add and modify items while the FDPA does not. Secondly, the FDPA has pre-inserted items while EDPA does not. Thus, students receiving EDPA were required to drill on their self-authored set of questions and answers while students receiving FDPA were required to drill on

readily available items. Both EDPA and FDPA apply free-response items and require students do self-assessment at the end of a quiz session. Free-response type items were used as they were easier to generate and really test the students' thinking as opposed to multiple-choice questions where students have the opportunity to identify the correct and wrong answer. These applications were developed by the researcher to avoid the impact of extraneous variable if different DPA were used. In addition, this gives the researcher more freedom in maintaining the DPAs when technical problems arise that need immediate fixing.

### Experimental Procedure and Data Collection

In the first week of the semester, the students were given instructions by their lecturer about the usage procedure of KAJI. They were also given a homogenous test to ensure that all students were at the same level of knowledge in terms of the course's content. EDPA and FDPA were given to Class A and Class B respectively. Students were required to use KAJI at least two times a week. Students with EDPA were also required to include all the important facts in their items which mostly are in their lecture notes. Student's use of KAJI is ensured by requiring them to submit a report that can be generated from KAJI at the end of each week which is a part of their course assignments. The HOTS test was given during the final week of lecture. The students were required to answer an essay type item. The scores were given by the lecturer based on the Washington State University Critical Thinking Rubric (WSUCTR) (Kelly-Riley, 2003).

### Data Analysis

The two versions of KAJI were given to two groups of students from the same course. Since the results of this study were based on HOTS test scores obtained from two different groups of students therefore, an independent-groups t-test was opted as the method for data analysis (Coakes, Steed, & Ong, 2010). This helped to detect any significant difference of HOTS scores between FDPA and EDPA conditions..

### RESULTS

As can be seen from Table 1 there is a statistically significant difference in HOTS scores for FDPA ( $M = 21.90$ ,  $SD = 3.19$ ) and EDPA ( $M = 23.20$ ,  $SD = 3.20$ ) conditions;  $t(118) = -2.23$ ,  $p < .05$ . It can be concluded that students treated with EDPA had significantly better HOTS scores than students treated with FDPA.

**Table 1 T-test Results for Comparing the Effect of EDPA and FDPA on Students' HOTS Scores**

Type of DPA	N	Mean	SD	T	df	Sig.
FDPA	60	21.90	3.19	-2.23	118	.028
EDPA	60	23.20	3.20			

The results from this study support the findings by Chin (2001). Chin (2001) found that activities that require students to ask questions would not only strengthen the students' present knowledge but also their level of HOTS. Chin (2001) showed that wonderment questions can stimulate deeper thinking to explain puzzling issues. Since the students using EDPA had no items to begin with, they were impelled to come up with wonderment questions all the time. This would ensure that all items would be more meaningful to the students compared to items

prepared in an FDPA protocol. The FDPA protocol is not much different than the conventional pen and paper drill except that FDPA is more interactive and provide faster feedback. However, like the conventional drill, students using FDPA were forced to accept the answers to the drill items regardless of their understandability of the question or the discussed matter as a whole. This condition would lead to poor command of prior knowledge that can hinder higher-level applications related to that particular knowledge as shown by the results of this study (see Mohammad Shah & Ahmad Jelani, 2015; McCoubrie, 2004; Zohar & Dori, 2003).

## **DISCUSSION**

It is generally accepted that conventional drill and practice only promotes fluency in repeating skills or concepts based on drill items prepared for them. Thus, it does not contribute much in helping students advance their knowledge or their HOTS as shown by the use of FDPA in this study. However, the results indicate that if students author their own items as they did using EDPA, their mastery of the knowledge and HOTS can be gradually developed. This finding simply shows that not all types of DPA are fall short of promoting HOTS. Higher learning institutions that would like to see improvement in students' thinking skills should consider providing teachers and students access to an EDPA system and promote its use.

## **CONCLUSIONS**

Over the years higher order thinking skills (HOTS) has assumed a very important and integral role in the world of education. However, there are a number of different techniques being applied in order to develop HOTS in students with varying degrees of success. This study attempts to examine one of them through the use of an editable drill and practice application (EDPA). As demonstrated through quantitative research in this paper, EDPA is shown to be more effective and efficient compared to its counterpart, FDPA, in developing and nurturing higher order thinking skills (HOTS) in students. EDPA has shown its potential for enhancing critical thinking of students and increasing their HOTS level by requiring them to ask questions and interact with the material in a direct manner. Wonderment questions as pointed out by Chin (2001) is key for developing HOTS and results of this research paper show that there was greater potential for wonderment questions in an EDPA session since students had no items to begin with which ensures greater meaning and comprehension as opposed to items in FDPA protocol.

Furthermore, FDPA can be very much equated with conventional drill where students are simply forced to accept the answers without having sufficient understanding of the questions or the subject matter. As a result, students are unable to get a full command over the knowledge that they have gained and are at a loss when it comes to the application of that knowledge in a more complex situation. Even though the results from this study have shown positive effects of EDPA on students HOTS, more related research is needed to support the findings. This study proposes a replication of this study except that the experiment should be slightly altered such that EDPA is provided with pre-inserted items as the same as those included in the FPDA. This is to ensure that both treatment groups receive almost the same treatment differing only at the ability to modify and add items. Nonetheless, based on the results and the underlying theories this study suggest that EDPA should be highly considered when promoting and developing higher-order thinking skills (HOTS) in students through learning with computer-aided learning applications.

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